BRITISH MUSEUM (NATURAL HISTORY)

BRITISH ANTARCTIC ("TERRA NOVA") EXPEDITION, 1910.

NATURAL HISTORY REPORT

BOTANY PART I. Pp. 1–16.

FRESHWATER ALGAE.

BY

F. E. FRITSCH, D.Sc., Ph.D., F.L.S.

WITH 10 PLATES

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The Trustees of the British Museum have undertaken the publication of the Natural History results of the British Antaretic ("Terra Nova") Expedition, 1910, sent out under the command of the late Capt. R. F. Scott, R.N., C.V.O. The arrangements for working out the botanical groups of specimens which had been made before the outbreak of the War have been hindered, and it has been possible so far to complete only the portions dealing with the Algae. These are: Part I.—An account of the Freshwater Algae, by Professor F. E. Fritsch; and Part II.—An account of the Marine Algae, by Mr. and Mrs. A. Gepp; the account of the Melobesieae in Part II. has been contributed by Mme. Lemoine.

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FRESHWATER ALGAE.

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A. INTRODUCTORY REMARKS.

The collections of freshwater Algæ made by the members of the British Antarctic ("Terra Nova") Expedition, 1910, were rather scanty and came from but two localities. Seven out of the eight bottles contained material gathered at Cape Adare, whilst the eighth sample consisted of fragments of one of the characteristic *Phormidium*-sheets from Cape Sustruzi, Evans Cove, latitude 75° South—*i.e.* both collections were made well within the Antarctic Circle. Of the seven samples from Cape Adare, all but one were practically identical in their contents, and I have not attempted to discriminate between them in the following. The material, which had been collected by Mr. R. E. Priestley, chiefly in December, 1911, consisted in the main of *Prasiola crispa* Menegh., with associated filamentous forms (cf. pp. 5–9). Intermingled were fragments of the sheets of three species of *Phormidium*, *Pleurococcus antarcticus* W. and G. S. West, *P. dissectus* Naeg., *Protoderma Brownii* F. E. Fritsch, and four species of *Navicula*. The other sample from Cape Adare, comprising pieces of rock, preserved dry, contained only a few small fragments of the *Prasiola*.

The sample from Cape Sustruzi was a perfectly typical *Phormidium*-sheet, with a fairly rich epiphytic flora, like those that have been described from the collections of earlier Antarctic expeditions (cf. the reports of Messrs. W. and G. S. West and F. E. Fritsch, cited in the subsequent matter). No Diatoms occurred in this sample.

Although the number of forms in the collections is relatively small, they are of interest as showing that the Cyanophyceous flora, and particularly that occurring on the *Phormidium*-sheets, is by no means exhausted. Thus the only pure *Phormidium*-sheets in the collections—namely, those from Cape Sustruzi—have added two new forms to the list of Antarctic Cyanophyceæ, viz., *Schizothrix antarctica* sp. nov. and *Nostoc fuscescens* F. E. Fritsch, var. *mixta*, var. nov. It is evident that collectors of freshwater Algæ in the Antarctic should in future pay particular attention to these huge strata of *Phormidium* and bring back material of them from as many diverse localities as possible. This is not to say that the Antarctic *Prasiolas* are not

worthy of further attention, but it is significant that the present collections do not add to the list of Green Algæ known to occur in the Antarctic.

In view of the great abundance of *Prasiola crispa* in these collections, I was led to make a somewhat careful study of the filamentous stages associated with it. As a glance at pp. 5–9 will show, these are sufficiently diverse, but I have not been able to convince myself that there are any actual specific differences between them—rather, they all seem connected by transitions with one another. If I have taken up a somewhat guarded attitude on this point, it is because the preservation of the material, and probably the conditions of collection, render certain features obscure.

I am indebted to my colleague, Dr. E. J. Salisbury, for certain suggestions and for the preparation of some of the illustrations, but the bulk of these latter are the work of my wife.

B. SYSTEMATIC ENUMERATION OF THE SPECIES.

ISOKONTAE.

CHLAMYDOMONADACEÆ.

Chlamydomonas Ehrenb.

Occasional individuals, probably belonging to this genus, were observed in some of the samples from Cape Adare, but they were too scanty in numbers and poorly preserved to admit of satisfactory determination. On the surface of the *Phormidium laminosum* from Evans Cove there occurred large round cells (diam. 27–36μ), with a relatively thin membrane and almost homogeneous contents, which in most cases were reddish-orange in colour, although sometimes nearly colourless. Within the cell-cavity a certain quantity of granular protoplasm was distinguishable. These cells should be compared with similar ones recorded from the Red Snow in the South Orkneys (cf. Fritsch, Journ. Linn. Soc., Bot., XL. pp. 318, 319, fig. D).

PROTOCOCCACEÆ.

1. Trochiscia tuberculifera L. Gain,

Flor. alg. reg. antarct. et subantarct., Deuxième Expéd. Antarct. Franç., Paris, pp. 175, 176, fig. 93 (1908–1910).

A few small specimens of this form (diam. 26–30μ) were observed in one of the samples from Cape Adare. Apart from the smaller size and the possession of a dark brown membrane, they agreed with Gain's description and figure. The contents were not decipherable, nor do Gain's figures cast any light upon their nature. For the present, therefore, it will be well to keep an open mind as to the possibility of these

cells not belonging to an algal organism at all. Similar cells were met with in the material of the Scottish National Antarctic Expedition, but they were ignored on the count of uncertainty as to their vegetable nature.*

PLEUROCOCCACEÆ.

2. Pleurococcus antarcticus W. & G. S. West, emend. F. E. Fritsch,
Nat. Antarct. Exped. 1912, Nat. Hist., VI., Freshw. Alg., p. 13. (Pl. I, figs. 18, 19.)

This species, which occurred only in the collections from Cape Adare, was not as abundantly represented as in the material of the National Antarctic Expedition, perhaps owing to the scarcity of the *Phormidium*-sheets, which evidently form a very suitable substratum for it. The cells were in part attached to such sheets, in part to the ubiquitous *Prasiola crispa*, but a large number appeared as though they had not been attached in any way. These free cells varied from 12–21μ in diameter, and were with or without pyrenoids. Of the various forms, only f. *typica*, f. *simplex*, f. *minor*, and (rarely) f. *filamentosa* were encountered.

In a few cases this species was found forming extensive sheets, the cells of which were often more than one layer deep, and exhibited a considerable range of size (fig. 18); some of them showed the small dimensions of f. *minor*, whilst others in the same sheet attained to 30–35μ. One or more drops of oil were commonly present in the larger cells, lying between the contents and the membrane (fig. 19), but on the whole such oil-formation was not very frequent. In a few cases the contents of the cells were observed to have undergone division into two (fig. 19), or even more, parts, and this no doubt represents the mode of propagation which hitherto had not been known. The chloroplast appears to be a curved peripheral plate, often occupying a great part of the circumference of the cell.

3. Pleurococcus dissectus Naegeli,
Gatt. einzell. Algen, p. 65, tab. IV. E, fig. 3 (1849).
Protococcus dissectus Kuetz., Phyc. germ. (1845), p. 144.

This was found attached to the sheets of *Prasiola* and *Phormidium*, as well as intermingled with the general mass of algal growth, from Cape Adare.

4. Protoderma Brownii F. E. Fritsch,
in Journ. Linn. Soc., Bot., XL. pp. 301, 328, Pl. X., fig. 1 (1912). (Pl. I, fig. 20.)

The rediscovery of this form has unfortunately not served to cast any further light upon it. The sheets were compact, and in part very extensive, like those found

* In several of the samples from Cape Adare colourless spherical cells, with a relatively thin membrane and a more or less distinct central nucleus, were observed (Pl. I, fig. 17). These cells either lay freely, or were attached in large numbers to the surface of some of the *Prasiola*-thalli. Nothing of the nature of a plastid could be distinguished, nor could starch be recognised after staining with iodine. It is possible that these cells belong to an organism of the type of *Myrococcus* Hansg., or *Myacanthococcus* Hansg.

in the "Yellow Snow." They agreed with those previously described, except that there was apparently no fat (but plenty of starch) in the cells, and the gelatinisation of the walls was much less pronounced. The sheets were often two or more layers of cells thick, and either occurred on the surface of the *Prasiola* or were quite free, having presumably been attached to the rock. They were encountered in most of the samples from Cape Adare. Diam. cell., 5–6μ.

PRASIOLACEÆ.

5. Prasiola crispa Kuetz.,
Phycol. gen. (1843), p. 295; Rabenh., Fl. Eur. Alg., III. p. 308 (1868). (Pl. I, figs. 1–15.)
Ulva crispa Lightf., Flor. Scot. II. p. 972 (1777).

This, the only species of the genus present in the collections, formed the bulk of the material in the samples from Cape Adare, where it evidently grows in great abundance, and has repeatedly been recorded. It may be well to draw attention to the fact that the cells of the mature thalli vary appreciably in appearance. On the one hand we have thalli in which the cells are dark green with homogeneous, somewhat opaque contents; the pyrenoid, and sometimes the chloroplast as well, are readily seen. This would seem to be the normal character of the cells. In the second case the cell-contents are granular, the pyrenoid being distinct; such cells are more or less transparent. This kind of cell sometimes occurs throughout entire thalli, but more frequently areas with the normal type occur intermingled among others with the granular type of cell. In still other cases the cell-contents appear quite homogeneous and somewhat opaque, but the colour is a bright green. Such cells seem to be in a moribund condition. It is not possible at the present time to place any interpretation on these features, but the writer harbours a suspicion that they may represent something in the nature of a reaction, on the part of this terrestrial Alga, to variations in the conditions of the habitat.

In the report on the Freshwater Algæ of the National Antarctic Expedition (Fritsch, loc. cit., pp. 17, 18, fig. A) certain large cells, frequently observed in the mature thalli of *Prasiola crispa*, were described and figured, these cells being interpreted as akinetes. Similar cells, often in very large numbers (Pl. I, fig. 11), were encountered, in the thalli of *Prasiola*, in the present material. They were, as a general rule, completely spherical, although more or less oval forms were also observed, the dimensions ranging from 12–19μ (most commonly 15–16μ). In most cases they occurred almost uniformly scattered, but here and there they were more closely crowded or even formed short irregular rows. These cells are provided with a thick, smooth, stratified membrane, and white, opaque, homogeneous contents, staining deeply with saffranin or methylene blue, and often showing a well-marked vacuole (Pl. I, fig. 12). They are surrounded by flattened cells, no doubt compressed by the enlargement of the thick-walled elements in question. The portions of the thalli containing the latter almost invariably consist of cells of the third type described

above, and exhibit an almost complete lack of that regularity of arrangement that characterises the ordinary *Prasiola*-thallus (cf. Pl. I, fig. 11).

A further study of these cells in the present material has raised some doubts as to whether they might not be due to some parasitic organism, like that described by Wille in a paper dealing with *Prasiola crispa* (Mitteilungen ueber einige von C. E. Borchgrevink auf dem antarctischen Festlande gesammelte Pflanzen, in Nyt Mag. f. Naturvidenskab, XL. 1902, p. 218). In examining thalli in which these large colourless elements occur, cells can generally be found which have failed to divide, so that they are larger than their neighbours. These cells, in most cases, have almost colourless contents, and at the best show only remnants of the chloroplast. It is possible that such larger cells are the forerunners of the round thick-walled "akinetes," and, if so, their colourless character and the disintegration of the chloroplast would certainly hint at the possibility of a parasitic organism being at work. To settle this point finally more carefully preserved material would be necessary, but for the present it will be well to keep an open mind on the subject.

Whether these elements be akinetes or the resting cells of some parasitic organism, they evidently become free from the thallus by decay, as large numbers of cells of this kind, still surrounded by disorganising remnants of the thallus, were encountered (Pl. I, fig. 13). As to their further fate there is no present evidence. In the earlier report it was suggested that they gave rise by division to the little spherical packets of cells (Fritsch, loc. cit., p. 18, fig. C, D) which appear to constitute stages in the life-history of *Prasiola*, and are found in large numbers upon and between its thalli. These packets vary between 17 and 21μ in diameter, so that they are, on the average, rather larger than the "akinetes." The connection between the two must at present be regarded as doubtful.

As regards the further development of the spherical packets themselves, stages were occasionally found in which the common membrane had burst open on one side, with the liberation of the contained cells. The irregular bunches of short *Hormidium*-threads (forma α below) observed at some points may well arise from such liberated cells. Small isolated cells, resembling those contained within the spherical groups, were often encountered lying quite freely.

A somewhat detailed study has been made of the filamentous forms, associated with the *Prasiola*-thalli, in the material from Cape Adare. The outcome has been the distinction of at least three different types which are occasionally found grading over into one another. Although it is not altogether impossible that these three forms do not all belong to *Prasiola crispa*, the material was not sufficiently well preserved to admit of coming to a certain decision on this point. I will describe these forms as α, β, and γ.

(α) The typical *Hormidium*-stage has been well figured by Messrs. W. and G. S. West (Freshw. Algæ, in Reports on the Scientific Investigations, British

Antarctic Expedition, 1907–9, Vol. I. Pl. XXIV, figs. 12, 13) and by Imhäuser (Entwickelungsgesch. u. Formenkreis v. *Prasiola*, Diss., Marburg, 1889, figs. 1, 2). The cells are much flattened, generally several times broader than they are long, the cavity often of slightly unequal width in the successive cells, and the contents in many cases exhibiting that highly refractive, homogeneous appearance which appears to imply a moribund condition (Pl. I, fig. 15). These dying or dead cells, in the Antarctic material, are often only separated by two or three living ones, so that in this way an extensive fragmentation of the filaments must occur—indeed, short lengths of filaments are very plentiful. The dead cells not uncommonly have a biconcave form, but many of them do not possess this special shape. The longitudinal walls of the threads are more or less thickened, whilst the transverse walls are very thin; the width of these filaments varies between 10 and 15μ.

Such filaments are frequently found showing longitudinal division and passing over apically into the typical *Prasiola*-stage; this condition has been repeatedly described and figured (cf. Gay, Recherches sur le développement et la classification de quelques Algues vertes, Thèse, Paris, 1891, Pl. XIII, fig. 128; Imhäuser, loc. cit., fig. 3).

Of this, the typical *Hormidium*-stage, a curious modification was observed now and again (Pl. I, fig. 14). This consisted in a thickening of the longitudinal walls in such a manner as to cause a succession of irregular bulges, with constrictions in between, the cell-cavities not being affected in any way. On the whole the inflations corresponded on the two sides of the filaments and tended to occur at more or less regular intervals, but there were exceptions to this. No stratification of the thickened parts was discernible. This may be described as var. *inflata*, and may be compared with the var. *aspera* of Messrs. W. and G. S. West (loc. cit., p. 273, Pl. XXIV, figs. 15–18), a form likewise characterised by a special differentiation of the longitudinal walls.

(β) The second filamentous form associated with the *Prasiola* is, in its most typical condition, very different from the *Hormidium*-stage just described—in fact, it is not altogether out of the question that it really is a species of the genus *Hormidium*, to which I was at first inclined to refer it. But all attempts to obtain clear pictures of the chloroplasts by staining have proved unsuccessful, and while the evidence hints at the chloroplast being plate-like rather than stellate, it is inconclusive. Moreover, the filaments of this form occasionally come to resemble those of form (α) very closely. For these reasons I have preferred to describe this form here, rather than possibly commit an error by referring it to a different genus.

The filaments of form (β) were, on the average, considerably longer than those of the typical *Hormidium*-stage above described, although short lengths were also encountered. The long filaments were highly flexuous, forming separate bright green tangles, which could often be picked out from the samples with the naked eye without

much difficulty. The filaments also occurred on the surface of the *Prasiola*-thalli, as well as on the sheets of *Phormidium*.

The cells were most commonly short, but not to so marked an extent as in form (α), being in general about half as long as broad (Pl. I, figs. 2, 3). Not uncommonly, however, the cells, along whole lengths of the filaments, were quadrate, or even longer than broad (up to twice as long as broad) (fig. 1). In the longer cells there were generally two pyrenoids; the cell-contents were homogeneous, or, more rarely, finely granular, as in form (γ). The filaments were interrupted at occasional intervals by dead cells with a biconcave or other shape (cf. fig. 2), but such cells were generally much rarer than in form (α), and the growth of (β) is evidently not as chequered as that of (α). The transverse walls were thin, whilst the longitudinal ones were slightly thickened. Occasionally a faint constriction was evident between the cells, or between successive groups of them, but in many cases there was no indication of this. The width of these filaments varied between 6 and 10μ, and it was sometimes very difficult to distinguish some of the wider threads of this form from the narrower ones of form (α). In a few cases the cells in the threads of form (β) showed a neat rounding-off of their contents, as though akinete-formation were taking place.

The cells of form (β), like those of the typical *Hormidium*-stage, were roughly cylindrical (*i.e.* circular in cross-section). At a few points, however, such threads with cylindrical cells were found passing over into ribbon-like ones, with the cells flattened in a plane containing the long axis of the filament (Pl. I, figs. 6, 10), the flattening being plainly visible when the filaments were viewed edgewise (fig. 10). Such ribbon-like threads generally occurred in dense tangles and, in the bulk of cases, betrayed no connection with the filamentous stage (β), but here and there such a connection was undoubtedly established (cf. figs. 6, 10). In these flattened filaments the cell-contents presented a peculiar aspect. They were of a light green colour, betrayed no trace of a pyrenoid, and generally showed more or less irregular longitudinal division into three or four parts lying side by side (cf. figs. 6–9). I have been unable to determine that these portions of the cell-contents were separated by any walls from one another, although at first sight the appearance of some of these filaments was remarkably like that of an incipient *Prasiola* (cf. fig. 21 on Tab. III. in Wille, loc. cit.). On the other hand, in others of these filaments, the appearance of the cells, with their fragmenting green contents, is remarkably like that of an *Ulothrix*-cell, when the chloroplast is commencing to undergo disintegration. It is partly the aspect of some of these flattened cells that makes me incline to the belief that the chloroplast is a plate in this form, in which case it is of course not referable to the genus *Prasiola*. These ribbon-like threads were generally encountered in large numbers crowded together, but on the whole they were rare.

Many of these flattened filaments included colourless spherical cells (Pl. I, figs. 6, 7, 9), resembling in all respects the similar elements above described as

occurring in the thalli of *Prasiola* (p. 4), except that they were of slightly smaller dimensions (diam. up to 12μ). The cells in question were considerably wider than the ordinary cells of the flat filaments, had the same homogeneous contents, sometimes with a central vacuole, and generally displayed remnants of compressed cells in their neighbourhood. These rounded cells were only observed in the flattened threads and never in the cylindrical form, although in one case (Pl. I, fig. 6) such a cell was observed very near the point where the cylindrical passed over into the flattened type.

It is difficult to say what interpretation is to be placed on these facts. If the ribbon-like threads are actually in a stage of disorganisation, it would of course be tempting to regard this as due to the same parasitic organism as infests the *Prasiola* and is accountable for the enlarged colourless cells, here and there alike. On the other hand, it is to be noted that many of the flattened filaments contain none of these cells, nor have I been able in this case to trace any indications of the possible origin of the large cells from the attacks of a parasite. It should be mentioned, however, that the ribbon-like threads containing these large spherical cells almost invariably occurred in close association with, or even upon, *Prasiola*-thalli showing the elements in question, which might again be taken as implying the attack of a common parasite.

Even if a parasite is concerned in both cases, it does not help to elucidate the actual status of the filamentous form (β), which can only be determined when the character of its chloroplast is known.

(γ) The third form is equally distinct from the other two in its typical condition. It occurs in the form of fairly long and slightly flexuous threads, 10μ in diameter and composed of cells which are slightly broader than long, or isodiametric (Pl. I, figs. 4, 5). The most marked distinguishing characteristic lies in the presence of more or less pronounced constrictions between the cells, which thus often come to be barrel-shaped (Pl. I, fig. 5). Further, the walls are rather thin throughout and the cell-contents finely granular; in the centre of the cell there is a prominent pyrenoid, but it has again proved impossible to decipher the chloroplast. The filaments of this form have a fresh appearance, and this agrees with the great scarcity of dead cells, which may often be sought for in vain, even in a long filament.

I was at first inclined to refer this form to *Ulothrix moniliformis* Kuetz., with which it shows considerable resemblance. Since it is possible, however, to find filaments in which one part shows the structure of form (γ), while another shows that of form (β), and since there is much variation in the degree of constriction between the cells in form (γ), it appears as though (γ) were merely a modification of (β). It may be added that the thread figured by Wille (loc. cit.) in fig. 2 (Pl. III) shows much resemblance with a filament of form (γ), except that there is no constriction between the cells.

I append brief Latin diagnoses of these different forms :—

forma α (Pl. I, fig. 15):—Filis in statu uniseriato cum cellulis cylindricis, diametro fili multo brevioribus, latitudine luminum sæpe paullo inæquali in cellulis successivis; cellulis refringentibus moribundis, interdum biconcavis, crebris; membrana exteriore cellularum satis incrassata, membrana transversa tenui. Diam. fil., 10–15μ. *Prasiolæ* status typicus filamentosus.

var. *inflata*, var. nov. (Pl. I, fig. 14):—Membrana exteriore cellularum irregulariter incrassata, ita ut fila inflationibus multis, plus minusve rotundatis, per constrictiones separatis, munita sint; alioquin hæc varietas similis est formæ *α*. Diam. fil. sine inflat., 12μ; cum inflat., 15μ.

forma β (Pl. I, figs. 1–3, 6–10):—Filis modo in statu uniseriato visis, multo longioribus quam in forma *α*, flexuosis, plus minusve intricatis, interdum paullo inter cellulas constrictis: cellulis cylindricis, diametro fili duplo brevioribus vel tam longis quam latis vel ad duplo longiores, cellulis longioribus cum pyrenoidibus binis; cellulis refringentibus moribundis sæpe multo infrequentibus quam in forma *α*. Fila cum cellulis cylindricis nonnunquam in fila tæniæformia, contentu cellularum plus minusve longitudinaliter in partes tres vel quatuor indistincte diviso, transeunt; fila tæniæformia sæpe cellulis majoribus sphæricis achrois, membrana incrassata (nescio an cellulæ perdurantes parasiti sunt) prædita sunt. Fortasse species distincta, ad genus *Hormidium* pertinens. Diam. fil. cylindr., 6–10μ; diam. fil. tæniæform., 8–9μ; diam. cell. sphær., 10–12μ.

forma γ (Pl. I, figs. 4, 5):—Filis modo in statu uniseriato visis, modice elongatis et flexuosis, inter cellulas plus minusve evidenter constrictis; cellulis cylindricis, interdum doliformibus, diametro fili paullo brevioribus vel tam longis quam latis, membrana sæpe tenui; cellulis refringentibus moribundis vel absentibus vel infrequentibus; contentus cellularum delicate granulosus, cum pyrenoide centrali conspicuo. Fortasse ad eandem formam pertinet quam forma *β*. Diam. fil., 10μ.

CYANOPHYCEAE (MYXOPHYCEAE).

CHROOCOCCACEÆ.

6. Chroococcus minutus Naegeli,
   Gatt. einzell. Algen (1849), p. 46; Rabenhorst. Fl. Eur. Alg., II, p. 30 (1865).
   Protococcus minutus Kuetz., Phycol. gen., p. 168 (1843).

Forming 2- and 4-celled colonies (diam. cell., 6–10μ) on the surface of *Phormidium laminosum* from Cape Sustruzi, Evans Cove.

7. Gloeocapsa Shuttleworthiana Kuetz.,
   Phycol. gen., p. 175 (1843), and Tab. Phycol., I, p. 18, t. 23, fig. 1.

Forming dark reddish-brown groups of varying size on the surface of *Phormidium laminosum* in the same locality as the last.

8. Microcystis marginata Kuetz.,
   Tab. Phycol., I, p. 6, tab. 8 (1846).
   Anacystis marginata Menegh., Consp. Alg. Eug., p. 6 (1837).

Amongst the *Prasiola* from Cape Adare.

9. Merismopedium tenuissimum Lemmermann,
   in Bot. Centralbl., LXXVI. p. 154 (1898).

Amongst the *Prasiola* from Cape Adare.

OSCILLATORIACEÆ.

10. Phormidium autumnale Gomont,
in Ann. Sci. Nat., Bot., 7 sér., XVI, pp. 187–190, Pl. V, figs. 23, 24 (1892), and Monogr. Oscillar., p. 207.
Oscillatoria autumnalis Ag., Disp. Alg. Suec., p. 36 (1812).

This was the commonest species of the genus in the samples from Cape Adare, occurring in the form of small fragments of almost pure sheets, and as a thin growth here and there on the *Prasiola*. The apex is exceedingly variable in this species; within the compass of the same stratum are found trichomes, capitate and non-capitate, and with tips which are straight or generally more or less curved. The septa were always distinct, frequently with rows of granules, whilst bacterial clusters were often present at the apices. The trichomes were generally between 5 and 6μ in diameter.

11. Phormidium Priestleyi sp. nov. (Pl. I, fig. 16.)

Stratum parvum (?), molle, læte æruginosum, pressione facile in partes minores disruptum; filis plerumque tortuosis et dense intricatis, interdum parallelis, stratum densum formantibus; vaginis aut distinctis aut mucosis, in muco hyalino diffluentibus; trichomatibus fragilibus, inter cellulas constrictis, plus minusve moniliformibus, apice non attenuato, cellula apicali rotundata; cellulis diametro duplo brevioribus, cytoplasmate dilute ærugineo, cum granulis paucis aut nullis; dissepimentis distinctis, sine granulis; calyptra nulla. Diam. trich., 3μ.

This species occurred in small quantity in the three or four samples collected at Cape Adare on Dec. 14th, 1911. It belongs to the section *Moniliformia* of Gomont, since the trichomes are more or less markedly constricted at the joints. A marked characteristic is the fragile character of the stratum, which, when subjected to slight pressure under a cover-glass, breaks up into a number of smaller masses.

The new species may be compared with *P. molle* Gom. and *P. foveolarum* Gom. From the former it differs in the nature of the stratum, which is not laminated, in the extremely tortuous character of the trichomes, in the short cells, and in the practical absence of granules. The principal differences from *P. foveolarum* are the colour and shape of the stratum, in the trichomes frequently not exhibiting a parallel arrangement, and in the greater width of the trichomes. Another similar form is *P. frigidum* F. E. Fritsch (loc. cit., p. 31), which differs, however, in the narrower trichomes and in the presence of granules at the dissepiments.

12. Phormidium laminosum Gomont,
in Ann. Sci. Nat., Bot., 7 sér., XVI, p. 167, Pl. IV, figs. 21–22 (1892), and Monogr. Oscillar., p. 187.

This constituted the bulk of the material collected at Cape Sustruzi, Evans Cove, and was the only mass of pure *Phormidium* present in the collections. It bore a rich epiphytic flora composed of *Chroococcus minutus*, *Gloeocapsa Shuttleworthiana*, *Schizothrix antarctica* sp. nov., and *Nostoc fuscescens* var. *mixta* var. nov.

13. Phormidium fragile Gomont, forma *tenuis*, W. and G. S. West,
in Brit. Antarct. Exp. 1907–9, Rep. Sci. Invest. I, p. 291, Pl. XXV, fig. 76.

In the shape of small fragments in the samples from Cape Adare. Crass. trich., 0·9–1μ.

14. Schizothrix antarctica sp. nov. (Pl. I, figs. 21–24.)

Thallus parvus, supra vel infra stratum *Phormidii* crescens, obscure violaceus vel purpureus; filis modice elongatis, vel dense intricatis vel more funiculi torqueatis vel patentibus, pseudoramosis; vaginis violaceis vel purpureis, semipellucidis, interdum leviter lamellosis, subamplis et firmis, marginibus glabris, non fimbriatis, apicem versus gradatim attenuatis; trichomatibus minutissimis, 1–2 intra vaginam, parallelis, inter cellulas probabiliter non constrictis. Longitudo cellularum, cellula apicalis, et dissepimenta ignota sunt. Pars interior cellularum cyanea.

Crass. fil., 4–6μ; crass. trich., 0·5μ; long. tot. fil. usque 600μ.

This interesting form was observed on the *Phormidium laminosum* at Cape Sustruzi, Evans Cove; it generally occurred just within the stratum of the *Phormidium*, and, owing to the endophytic habit and the coloration of the sheaths and trichomes, it has proved impossible to decipher the detailed structure of the latter, even under high powers of the microscope. It, however, appears to be sufficiently distinct to warrant the establishment of a new species, even without these particular characteristics being known.

S. antarctica is another of the species of the genus with minute filaments, like *S. affinis* Lemm. (in Abhandl. Nat. Ver., Bremen, XVIII. p. 153, t. XI, figs. 2, 3), *S. delicatissima* W. and G. S. West (in Journ. Bot., 1897, p. 269), and *S. fumalis* W. and G. S. West (in Journ. Roy. Microscop. Soc., 1896, p. 164). Of these three, however, only the first and third have coloured sheaths, and the coloration is quite different from that of *S. antarctica*. In its endophytic habit this species resembles *S. havaiensis* Lemmermann (in Engl. Bot. Jahrb., XXXIV. pp. 620, 621, t. VIII, fig. 19), but this is a form with larger filaments growing in hot water.

NOSTOCACEÆ.

15. Nostoc fuscescens F. E. Fritsch.
loc. cit., pp. 41–43, Pl. III, figs. 138–144.

Var. *mixta* var. nov. (Pl. I, figs. 25–31):—Vaginis in thallis juvenilibus sæpe absentibus vel imperfecte effiguratis, ita ut thalli interdum fere achroi sint. Vaginæ "lamellatæ, plerumque in duas regiones disjunctæ" quæ in specie typica inveniuntur (Fritsch, loc. cit., p. 41), modo in thallis minutissimis, modo solum in thallis senioribus adsunt. Thalli seniores sæpe cum regione exteriore vaginarum non diffluenti, distincte delimitata (ut in regione interiore), mesenterica, nigro-fuscescenti, fere opaca, valde constricta (constrictionibus non cum cellulis congruentibus). Cellulæ paullo majores quam in forma typica, arcte dispositæ.

Diam. cell. veg., 4·5μ; diam. heterocyst., 6–6·5μ: diam. reg. inter. vagin., 9–10μ; diam. reg. exter. vagin., 15–24μ: diam. colon. usque ad 1 mm.

This variety formed small spherical colonies (Pl. I, fig. 25) on the surface of the *Phormidium* from Cape Sustruzi, Evans Cove. The older colonies very readily

become detached and appear to get somewhat flattened out. The colonies exhibited the following three types of differentiation :—

(*a*) General mucilage practically colourless ; sheaths of the individual trichomes in great part indistinguishable ; where recognisable, the sheath is wide, brownish-yellow in colour, and granular (fig. 28). Colonies white or pale yellow, according to the number of trichomes provided with a sheath.

(*b*) General mucilage yellowish ; trichomes in part, or almost entirely, provided with a double sheath, the inner region dark-brown and with very obvious constriction between the cells, the outer region brownish-yellow and granular as in (*a*), the two being separated by a clearer space (fig. 27). Colonies dark-brown.

(*c*) General mucilage yellowish ; trichomes in great part provided with a double sheath, the inner region as in (*b*), the outer likewise dark-brown and exhibiting repeated constrictions, which are, however, fewer in number than the contained cells (figs. 29, 30). The two sheaths are separated by a clearer space and, in their joint effect, are so opaque that the contained trichomes are only faintly seen. Colonies blackish-brown, appearing to the naked eye almost black. In such colonies filaments can also be found in which only the outer sheath is present.

The sequence of development of the complex sheaths of the trichomes in this variety seems to be as follows :—(1) sheath simple, brownish-yellow and granular (fig. 28, upper portion) ; (2) thickening of the inner part of this sheath to form a firm, inner, dark-brown region (fig. 28, lower portion, and fig. 27) ; (3) thickening of the outer part of the sheath to form a second firm, outer, dark-brown region (figs. 29, 30). It appears that the thick inner and outer sheaths are produced by a gradual accumulation of the granular matter recognisable in the sheath at its first inception (cf. figs. 28, 29). It is not difficult to find various stages which indicate the progressive development outlined above. The double dark-brown sheath of the mature trichome is very evident, when such trichomes are viewed in optical section (fig. 31), and, in such aspects, a fainter median sheath is sometimes recognisable between the inner and outer ones. The appearance of the colonies in the final stage is extremely curious ; within the circular boundary of the whole lie a large number of much contorted, wide, worm-like filaments, showing repeated constrictions and almost black, or deep brown, in colour, so much so that strong illumination is necessary to make the contained trichomes visible.

My reason for referring this form, as a variety, to the *Nostoc fuscescens*, previously recorded by me from the Antarctic, is that the colonies in stage (*b*) above are practically indistinguishable from those of the species in question. The trichomes are quite similar, being rather loosely aggregated and very much contorted, with almost spherical or barrel-shaped (rarely elliptical) cells, and spherical or elliptical heterocysts which are nearly twice as wide as the vegetative cells. The more important differences are : the ultimate development of the characteristic double sheath (stage (*c*) above) to the trichomes ; the mesenteric character of the outer sheath, whose constrictions do

not correspond to the cells of the contained trichome; and the slightly larger cells which are more closely connected. Another marked peculiarity of the variety lies in the fact that the gradual differentiation of the sheaths does not go hand in hand with increase in size of the colonies. In some cases the trichomes show the typical double sheath already in quite small colonies containing only a few trichomes, whilst in other cases a colony may reach almost the maximum size observed before any sign of a sheath is discoverable. This is very different from what was observed in the type (Fritsch, loc. cit., p. 42, and Pl. III, fig. 139), where even young colonies show elaborate sheaths about the trichomes. It should be added that all the colonies found were small and in no way attained to the large size of those of the type. It is possible, however, that subsequent collections may show that the variety also may reach considerable dimensions.

In the previous report (Fritsch, loc. cit., p. 42) it was suggested that *Nostoc pachydermaticum* L. Gain ("Comptes Rendus," CLII, pp. 1693–4 (1911)), might possibly be identical with *N. fuscescens*, although there were considerable differences. Since then Gain's full report has appeared ("La flore algologique des régions antarctiques et subantarctiques," Deuxième Expédition Antarctique Française (1908–1910), Paris), together with figures of his species (loc. cit., pp. 170, 171, fig. 88 bis, and Pl. III, figs. 5, 6), and I am now inclined to take the view that it is merely a form of *Nostoc fuscescens*, var. *mixta*. The most striking differences, from either the variety or the type, lie in the prevalent elliptical shape of the cells and apparently in their colour ("articles brunâtres"), although it is possible that Gain has not distinguished the inner sheath from the contained trichome. His text-figure on p. 170 and fig. 6 on Pl. III. recall very strongly the appearance of the filaments of *N. fuscescens*, var. *mixta*, in their final stage (cf. my fig. 30), except that no inner sheath is apparent. I would suggest, therefore, that Gain's species be referred, as a forma *elliptica*, to this variety, the form being distinguished by its elliptical cells and the less sinuous character of the trichomes (cf. loc. cit., p. 171).

BACILLARIEAE.

COSCINODISCACEÆ.

16. Melosira sp. F. E. Fritsch,
loc. cit., p. 46, Pl. III, figs. 148, 149, 149a.

A few specimens of this form (diam. cell., 10μ; long. cell., 12μ) were observed in the samples from Cape Adare. They did not serve to cast any further light on its nature.

NAVICULACEÆ.

17. Navicula muticopsiforme W. and G. S. West,
loc. cit., p. 284, Pl. XXVI, fig. 131.

In small quantity from Cape Adare. Long. valv., 10–12μ; lat. valv., 5–6μ.

18. Navicula muticopsis Van Heurck,
"Diatomées," Résult. d. voyage du S.Y. "Belgica" (1909), p. 12, Pl. II, fig. 181.

The most abundant of the Diatoms in the material from Cape Adare, both forma *evoluta* and forma *reducta* W. and G. S. West, being present. Regarding forma *capitata* Carlson, see under *N. dicephala* below.

19. Navicula Murrayi W. and G. S. West,
loc. cit., p. 285, Pl. XXVI, fig. 129.

Not uncommon in the samples from Cape Adare. Long., 38–40μ; lat., 11·5–12μ. The variety *elegans* W. and G. S. West was also observed.

20. Navicula dicephala Ehrenb.
Inf. p. 185 (1838); W. Smith, Synops. Brit. Diatom. I, p. 53, Pl. XVII, fig. 157 (1853).

Forma. The form shown on Pl. I, fig. 32, was common in the material from Cape Adare. The sides are parallel or slightly convex, and show attenuation before the apical constrictions are reached. The inflated terminal portions are narrower than the median part of the frustule and have flat or slightly rounded ends. The striæ, which are throughout punctate, converge markedly in all parts of the valve and are continued as short streaks round the capitate ends. Length of the valve, 22–35μ (mostly 22–27μ); breadth, 10–11μ; striæ 12–13 in 10μ.

This differs from the published descriptions of *N. dicephala* mainly in the number of striæ per 10μ. Carlson (in Wiss. Ergebn. Schwed. Suedpol.-Exped., 1901–1903, IV, p. 15, Tab. I, fig. 19) has described a forma *capitata* of *N. muticopsis* Van Heurck, which very closely resembles this—in fact, the two forms are clearly identical. There is no doubt that some of the forms of *N. muticopsis* approach very closely to this capitate one, but those I have seen (cf. also the figures given by Messrs. W. and G. S West, loc. cit., Pl. XXVI, figs. 121–124) are never more than might be described as subcapitate. There appears to be a distinct line of demarcation between these specimens and the definitely capitate ones. This, taken together with the greater length occasionally attained by the latter, may be sufficient to mark them off as belonging to a distinct species. I have preferred for the present to refer them to *N. dicephala*, but future experience may show that this is, after all, but a form of *N. muticopsis*. It should be added that the Diatom described and figured in outline from the South Orkneys (Fritsch, in Journ. Linn. Soc., Bot., XL. p. 336, text-fig. B) as *N. muticopsis* is undoubtedly the same form as that here described.

Note added January, 1917:—Since the preceding report was written, another sample from Cape Adare (Campbell, 21.3.1911, No. 18) has been handed to me. This does not differ, however, in any marked respect from those dealt with in the main report, consisting chiefly of *Prasiola crispa* with a large quantity of the typical *Hormidium*-stage (forma *a*, above).

INDEX.

DESCRIPTION OF FIGURES ON PLATE I.

Fig. 25, natural size ; figs. 11 and 21, × 220 ; figs. 18, 30, and 31, × 400 ; figs. 4, 5, 20, 22, and 23, × 850 ; fig. 32, × 1000 ; fig. 19, × 1100 ; all other figures, × 550.

Figs. 1–3. *Prasiola crispa* Kuetz., filaments of forma β (cf. p. 6) ; *c*, in fig. 2, one of the bieoncave cells.

Figs. 4, 5. *Prasiola crispa* Kuetz., filaments of forma γ (cf. p. 8).

Figs. 6–10. *Prasiola crispa* Kuetz., filaments of forma β (cf. p. 6). 6 and 10, cylindrical filament (f) passing over into the ribbon-shaped type (r) ; in fig. 10 the filament is twisted showing the flat character, when viewed edgewise. 7, 8, and 9, threads of the ribbon-shape type, in the case of figs. 7 and 9 with the large colourless cells described on p. 7.

Figs. 11–13. *Prasiola crispa* Kuetz., the adult condition. 11, thallus, at a low magnification, to show the abundant spherical colourless cells (cf. p. 4) ; 12, small portion of the latter on a larger scale showing three of the cells in question ; 13, a single one of the latter which has become free from the thallus by decay.

Fig. 14. *Prasiola crispa* Kuetz., var. *inflata* var. nov.

Fig. 15. *Prasiola crispa* Kuetz., filament of forma *a* (typical *Hormidium*-stage).

Fig. 16. *Phormidium Priestleyi* sp. nov.

Fig. 17. Colourless cell from Cape Adare, cf. footnote on p. 3.

Figs. 18, 19. *Pleurococcus antarcticus* W. and G. S. West. 18, Portion of a sheet, as described on p. 3 ; 19, single cell, with dividing contents.

Fig. 20. *Protoderma Brownii* F. E. Fritsch, small portion of a sheet.

Figs. 21–24. *Schizothrix antarctica* sp. nov. 21, single specimen at a fairly low magnification ; 22, apex of one of the filaments ; 23, portion of a plant, more strongly magnified ; 24, portion of a plant, showing the rope-like intercoiling of the filaments.

Figs. 25–31. *Nostoc fuscescens* F. E. Fritsch, var. *mixta* var. nov. 25, colonies, natural size, some almost black, some colourless ; 26, single trichome, without sheath ; 27, single trichome, with firm inner (i.s.) and gelatinous outer sheath (o.s.) ; 28, trichome, with gelatinous, granular sheath, in which the inner firmer region is beginning to develop at the lower end ; 29, trichome with inner and incipient outer sheaths ; 30, trichome in the mature condition ; 31, the same in optical section.

Fig. 32. *Navicula dicephala* Ehrenb., forma.

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